ME3023 Challenge 4 Background

Information:

- Handheld oscilloscope and power supply module introduction video links
- Resistor Chart and Capacitors Codes
- Breadboards and some simple wiring layouts
- Series and Parallel Resistor Formulas
- Wheatstone Bridge Formulas

Some History: While analog devices have been supplanted by their digital equivalents in many applications, they are still widely used and remain engrained in engineered devices. An analog output format is often ergonomically superior in monitoring, as evidenced by modern car speedometer dials and dial wristwatches. Too often we qualify a digital device by its digital readout, but internal analog circuits form the foundation for both analog and many digital indicating systems. In fact, many of the systems that we interface with are analog and digital hybrids. Within a signal chain, it is common to find digital and analog electrical devices being used together and so requiring special signal conditioning. An understanding of analog device function provides insight, as well as a historical reference point, into the advantages and disadvantages of digital counterparts.

Handheld Oscilloscope Video:
https://www.youtube.com/watch?v=EA1v2LcCgro

Power Supply Module Video:
https://www.youtube.com/watch?v=i9l51qYtpJM

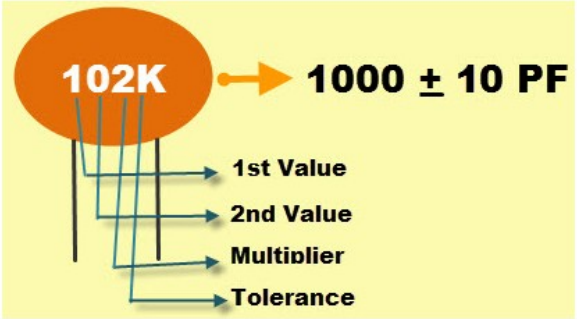
Capacitors (passive electrical elements)

Polarized Capacitor

Non-polarized Capacitor

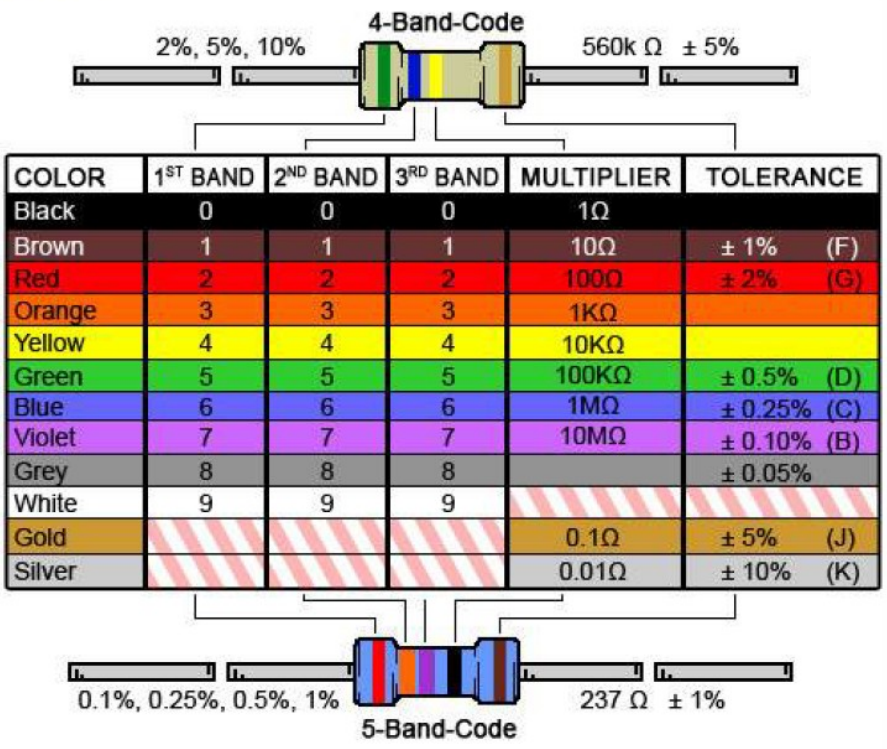
Capacitor Codes

Code	Tolerance	Code	Tolerance
A	± 0.05 pF	K	± 10 %
B	± 0.1 pF	L	± 15 %
C	± 0.25 pF	M	± 20 %
D	± 0.5 pF	N	± 30 %
E	± 0.5 %	P	-0 to 100 %
F	± 1 %	S	-20 to 50 %
G	± 2 %	W	-0 to 200 %
H	± 3 %	X	-20 to 40 %
J	± 5 %	Z	-20 to 80 %



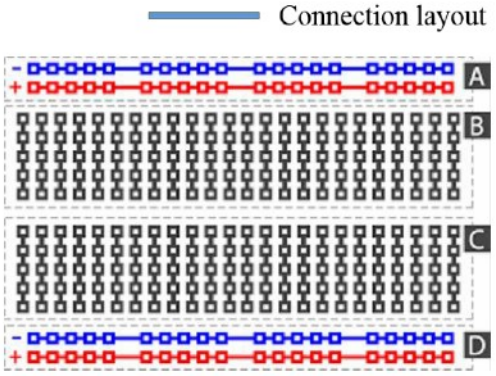
Resistors

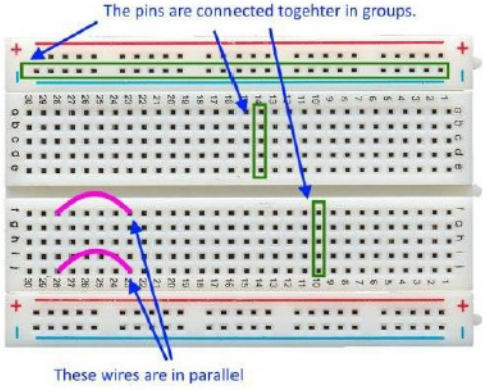
Resistor Chart

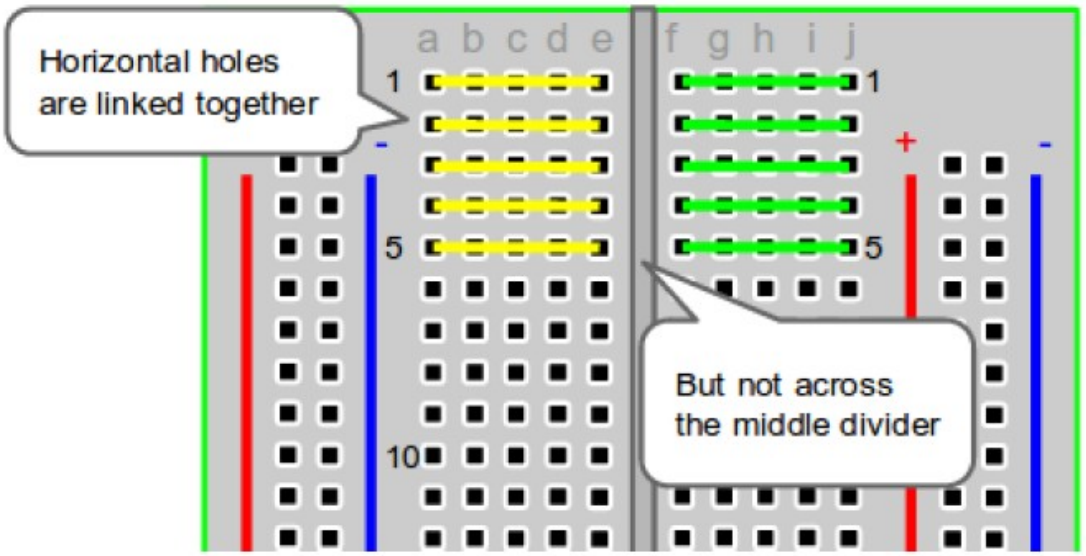


COLOR	1ST BAND	2ND BAND	3RD BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1% (F)
Red	2	2	2	100Ω	± 2% (G)
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	± 0.5% (D)
Blue	6	6	6	1MΩ	± 0.25% (C)
Violet	7	7	7	10MΩ	± 0.10% (B)
Grey	8	8	8		± 0.05%
White	9	9	9		
Gold				0.1Ω	± 5% (J)
Silver				0.01Ω	± 10% (K)

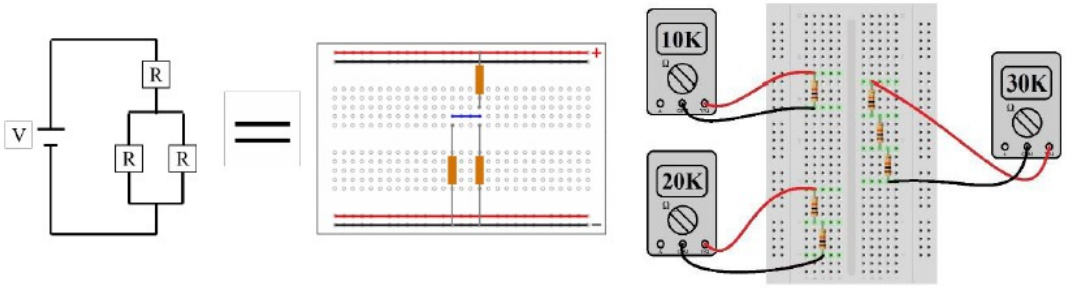
Breadboard: Pin diagram



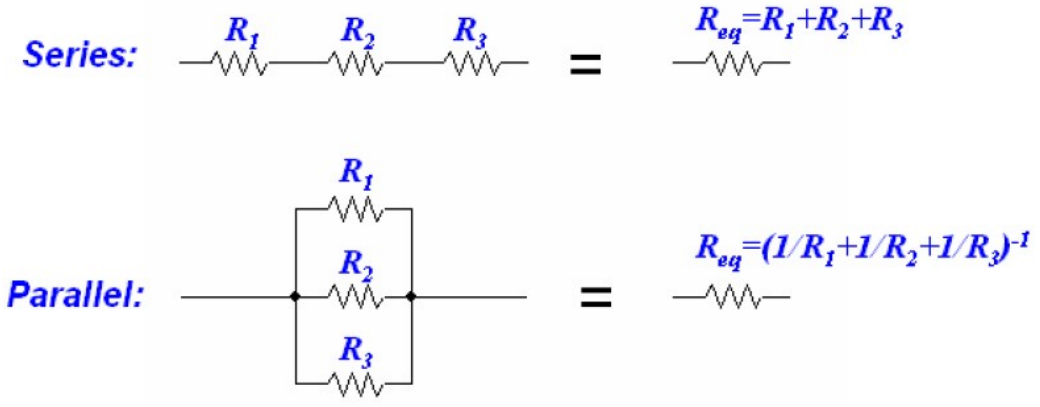




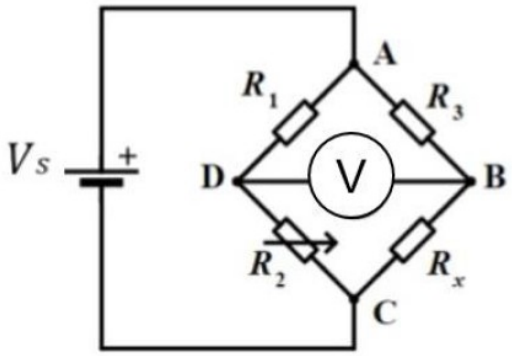
Breadboard Layouts: 2 examples



Useful Formulas



Wheatstone Bridge – the setup shown is for detecting an unknown resistance value, Rx. The R2 is a variable resistor that is used to balance the bridge.



$$\frac{R_x}{R_3} = \frac{R_2}{R_1}$$

$$R_x = R_3 \frac{R_2}{R_1}$$

$$V = \left(\frac{R_1}{R_1 + R_2} - \frac{R_x}{R_x + R_3}\right) V_S$$

Useful links for more information (Circuit)

Voltage Dividers
https://learn.sparkfun.com/tutorials/voltage-dividers/all

Wheatstone Bridge
https://www.electronics-tutorials.ws/blog/wheatstone-bridge.html

https://www.grc.nasa.gov/www/k-12/airplane/tunwheat.html

Resistance
https://opentextbc.ca/physicstestbook2/chapter/resistors-in-series-and-parallel/

Capacitors
https://www.wikihow.com/Read-a-Capacitor

https://learn.sparkfun.com/tutorials/polarity/all